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PALYNOLOGY OF SKULL CREEK-1

OTWAY BASIN, VICTORIA

BY

ROGER MORGAN

CONTENTS

1 SUMMARY

1125-1130m (cutts), 1145-50m (cutts) : middle *senectus* Spore-pollen Zone (upper *aceras* Dinocyst Zone) with caved Middle Eocene, Early Eocene, late Paleocene and Maastrichtian (*longus/druggii* Zones) : early Campanian : nearshore marine : immature : usually upper Belfast Mudstone and correlative lower Paaratte Formation.

1155-1160m (cutts) : apparently middle *apoxyexinus* Spore-pollen Zone (lower *cretacea* Dinocyst Zone) with mixed younger caving : Santonian : very nearshore marine : immature : usually mid Belfast Mudstone and correlative basal Paaratte Formation.

1175-1180m (cutts) : apparently middle *apoxyexinus* Spore-pollen Zone (no Dinocyst Zone possible) with mixed younger caving : Santonian : marginal marine : immature : usually mid Belfast Mudstone and correlative basal Paaratte Formation.

1185-1190m (cutts) : apparently lower *mawsonii* Spore-pollen Zone (*infusorioides* Dinocyst Zone) mixed with caved middle *apoxyexinus* Spore-pollen Zone (no Dinocyst Zone) and mixed younger presumed caving : Turonian : very nearshore marine : immature : usually basal Belfast Mudstone/upper Flaxmans Formation/uppermost Waare Sandstone.

1195-1200m (cutts), 1278-1281m (cutts) : nothing older seen and samples appear to be mostly mixed younger caving : may be mixed caving in lean sandy lithologies.

1287-1290m (cutts) : *paradoxa* Zone (no Dinocyst Zone with dinoflagellates probably entirely caved) with mixed younger caving : probably Albian : probably non-marine : marginally mature : usually Eumeralla Formation.

2 INTRODUCTION

Eight cuttings samples were studied after drilling at the request of Alex Pomilio. An initial breakdown was faxed on 11/7/96, and the final results are summarised herein.

Palynomorph occurrence data are shown as Appendix I and form the basis for the assignment of the samples to six units of Campanian to Albian age. Younger caving is also detailed.

Specimen counts were made on all assemblages and expressed in the raw data as percentages.

The Cretaceous spore-pollen zonation is essentially that of Dettmann and Playford (1969), but has been significantly modified and improved by various authors since, and most recently discussed in Helby et al (1987), as shown on Figure 1. The Late Cretaceous zonation has been refined by Morgan (1992) in project work (Figure 2).

Maturity data was generated in the form of Spore Colour Index, and is plotted on Figure 3 Maturity Profile of Skull Creek-1. The oil and gas windows on Figure 3 follow the general consensus of geochemical literature. The oil window corresponds to spore colours of light-mid brown (Staplin Spore Colour Index of 2.7) to dark brown (3.6). These respond to vitrinite reflectance values of 0.6% to 1.3%. Geochemists argue variations on kerogen type, basin type and basin history. The maturity interpretation is thus open to reinterpretation using the basic colour observations as raw data. However, the range of interpretation philosophies is not great, and probably would not move the oil window by more than 200 metres.

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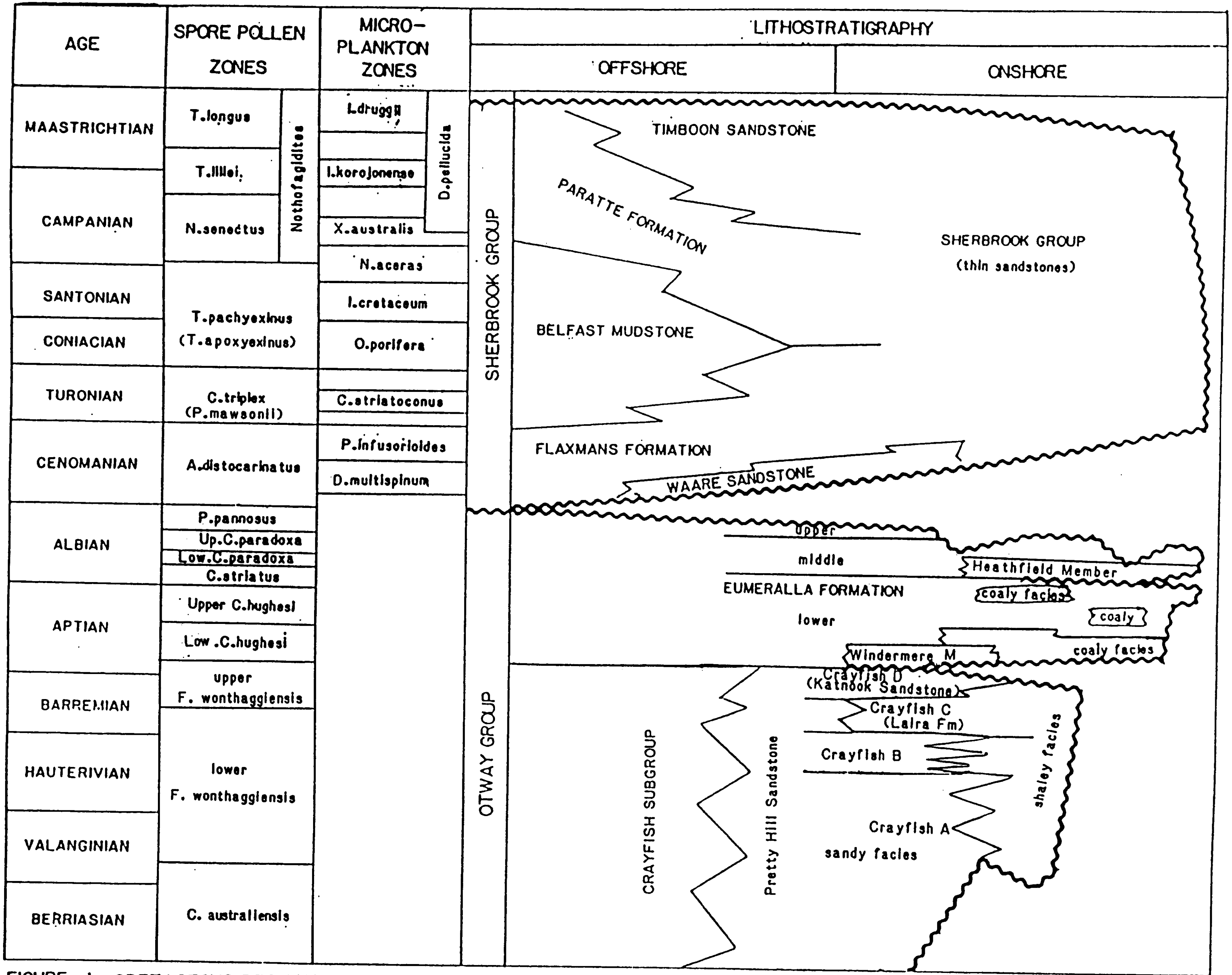

FIGURE 1. CRETACEOUS REGIONAL FRAMEWORK, OTWAY BASIN

AGE	SPORE-POLLEN ZONES		DINOFLAGELLATE ZONES	
MAASTRICHTIAN	LONGUS	upper	DRUGGII	
		lower		
CAMPANIAN	LILLEI	upper	KOROJONENSE	
		lower		
	SENECTUS	upper	AUSTRALIS	upper
				lower
		middle	ACERAS	upper
		lower		middle
				lower
SANTONIAN	APOXYEXINUS	upper	CRETACEA	upper
				lower
		middle	PORIFERA	upper
		lower		lower
CONIACIAN	MAWSONII	upper	STRIATOCONUS	
TURONIAN		lower	INFUSORIOIDES	
CENOMANIAN	DISTOCARINATUS			

FIGURE 2 DETAILED ZONATION USED HEREIN

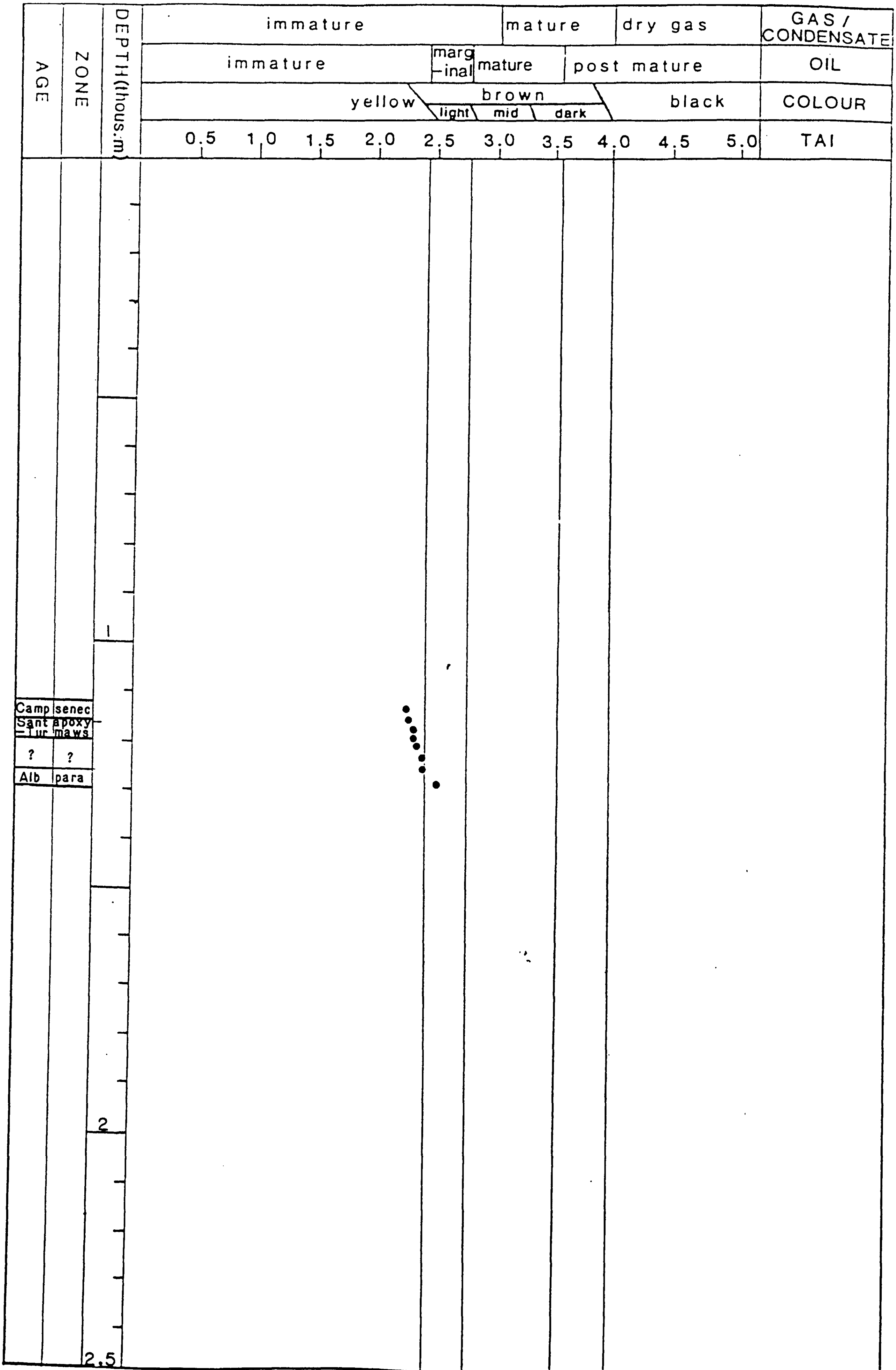

FIGURE 3 : MATURITY PROFILE - SKULL CREEK-1

3 PALYNOSTRATIGRAPHY

3.1 1125-30m (cutts), 1145-50m (cutts) : middle *senectus* Spore-pollen Zone (upper *aceras* Dinocyst Zone)

Assignment to the middle Subzone of the *Nothofagidites senectus* Spore-pollen Zone is indicated by the dinoflagellates present. On the basis of the spores and pollen seen, these cuttings might be assigned to much younger Zones, but the markers are considered caved. Assignment to the upper *Nelsoniella aceras* Dinocyst Zone of early Campanian age is on youngest *Nelsoniella tuberculata* at 1125-30m, without older markers. Also consistent are *Nelsoniella semireticulata* and *Xenikoon australis* down to 1145-50m, although these could be caved. Amongst the scarce dinoflagellates, *Heterosphaeridium* spp and *Spiniferites* spp are the most frequent with rare *Nelsoniella* spp and *Trithyrodinium* spp. Obviously caved are the Middle Eocene *Alisocysta ornata, Corrudinium incompositum* and *Heteraulacysta sp*, the Early Eocene *Apectodinium homomorphum*, the late Paleocene *Deflandrea obliquipes, Cordosphaeridium inodes* and *Hafniasphaera septata* and the Maastrchtian *Manumiella coronata.*

Given these dinoflagellate data, spores and pollen considered in place include *N. senectus*, *Nothofagidites endurus* and *Tricolpites sabulosus*, consistent with the correlative middle *senectus* Spore-pollen Zone. Considered caved are Middle Eocene *Nothofagidites falcatus, Malvacipollis subtilis*, Paleocene *Lygistepollenites balmei, Gambierina rudata* and Maastrichtian *Stereisporites punctatus, Tricolpites confessus*. Overall, *Falcisporites similis* is common with *Cyathidites minor, Dilwynites granulatus, Gleicheniidites, Podosporites microsaccatus, Proteacidites* spp and *Vitreisporites pallidus* frequent.

Nearshore marine environments are suggested by the dominant and diverse spores and pollen, minor dinoflagellates and common freshwater algae *Botryococcus*. However, in these cuttings, much of the observed microflora may be caved.

Yellow to light brown spore colours indicate immaturity for hydrocarbons.

These features are usually seen in the upper Belfast Mudstone, correlative Paaratte Formation, and other correlatives.

3.2 1155-60m (cutts) : apparently middle *apoxyexinus* Spore-pollen Zone (lower *cretacea* Dinocyst Zone)

Assignment to the middle *Tricolporites apoxyexinus* Spore-pollen Zone is indicated by the associated dinoflagellates. On the basis of spores and pollen, a younger assignment might be suggested, but key markers are considered caved. Assignment to the lower Subzone of the *Isabelidinium cretaceum* Dinocyst Zone of Santonian age is indicated by *I. cretaceum* without younger (especially *Nelsoniella* or *Amphidiadema* spp) or older markers. Considered caved are the Middle Eocene *C. incompositum,* Early Eocene *Homotriblium tasmaniense,* and Maastrichtian *Manumiella druggii. Heterosphaeridium heteracanthum* is the most common dinoflagellate and rare *Isabelidinium balmei* and *Trithyrodinium suspectum* are considered in place.

Given the dinoflagellate data, caved spores and pollen include Middle Eocene-Paleocene *H. harrisii, Nothofagidites emarcidus* and Maastrichtian-Campanian *N. endurus, N. senectus* and *T. sabulosus.* Overall, *F. similis* is common, with *Australopollis obscurus, C. minor, D. granulatus, H. harrisii, P. microsaccatus* and *Proteacidites* frequent.

Very nearshore marine environments are suggested by the very low dinoflagellate content and low "*in situ*" diversity, abundant and diverse spores and pollen and common *Botryococcus.* However, these assemblages may be largely caved.

Yellow to light brown spore colours indicate immaturity for hydrocarbons.

These features are normally seen in the mid Belfast Mudstone, correlative basal Paaratte Formation and other correlatives.

3.3 1175-1180m (cutts) : apparently middle *apoxyexinus* Spore-pollen Zone (no Dinocyst Zone)

Assignment to the middle *T. apoxyexinus* Spore-pollen Zone of Santonian age is on the zonal assignment of the sample above, and the lack of older markers. *Amosopollis cruciformis* is rare in this sample. Overall, *F. similis* is very common, with *D. granulatus* and *P. microsaccatus* common, and *C. minor, Gleicheniidites* and *V. pallidus* frequent. Considered caved are the Eocene *H. emarcidus, H. harrisii, M. subtilis* and Maastrichtian-Campanian *G. rudata, T. confessus* and *T. sabulosus.*

Dinoflagellates are non-descript and lack zonal markers considered in place. Most consistent are *Heterosphaeridium* spp and *Spiniferites* spp. Considered caved are Eocene *A. ornata* and Paleocene *Deflandrea dartmooria*.

Marginal marine environments are indicated by the very scarce dinoflagellates considered in place, the common and diverse spores and pollen and common freshwater *Botryococcus*. However, these assemblages may be largely caved.

Yellow to light brown spore colours indicate immaturity for hydrocarbons.

These features are usually seen in the mid Belfast Mudstone and correlative basal Paaratte Formation and other correlatives.

3.4 1185-90m (cutts) : apparently lower *mawsonii* Spore-pollen Zone (*infusorioides* Dinocyst Zone)

Assignment is on the dinoflagellate data, namely youngest *Cribroperidinium edwardsii*, indicating the *Palaeohystrichophora infusorioides* Dinocyst Zone of Turonian age, and the correlative lower *Phyllocladidites mawsonii* Spore-pollen Zone. Of the dinocysts, only *Heterosphaeridium* spp and *C. edwardsii* are considered in place, with caved Eocene *A. homomorphum, Deflandrea phosphoritica* and *Achomosphaera crassipellis*, Maastrichtian *M. coronata*, Campanian *N. aceras* and Campanian-Santonian *Odontochitina porifera*.

Amongst the spores and pollen, *P. mawsonii* is considered in place, but the 3% *A. cruciformis* with 8% *Proteacidites* suggests caving from the mid *apoxyexinus* Zone. Definitely caved are the Eocene-Paleocene *H. subtilis, H. harrisii, L. balmei* and the Maastrichtian-Campanian *T. confessus*. Overall, *D. granulatus* and *P. microsaccatus* are common with *F. similis, Proteacidites* and *V. pallidus* frequent.

Marginal marine environments are suggested by the scarce dinoflagellates considered in place, the abundant and diverse spores and pollen, common freshwater algae *Botryococcus* and common plant cuticle.

Yellow to light brown spore colours indicate immaturity for hydrocarbons.

These features are normally seen in the basal Belfast Mudstone and correlative upper Flaxmans Formation and uppermost Waare Sandstone and their correlatives.

3.5 1195-1200m (cutts), 1278-1281m (cutts) : nothing older seen, mostly caved

These samples are leaner than those overlying, contain nothing new, and a higher content of caved material. This would be consistent with lean sandy lithologies yielding poorly, with the caving therefore a higher proportion of the assemblage. Overall, *F. similis* is common, with *C. minor, Gleicheniidites, Microcachryidites antarcticus, P. microsaccatus, Proteacidites, S. antiquasporites* and *V. pallidus* frequent. Obviously caved are Eocene-Paleocene *Anacolosidites acutullus, H. harrisii, Malvacipollis diversus, N. emarcidus, Proteacidites incurvatus, Proteacidites grandis* and *Spinozonocolpites prominatus* and Maastrichtian-Campanian *G. rudata, N. endurus, N. senectus, Oramentifera sentosa.* Possibly in place is *P. mawsonii,* although it too is likely to be caved. Rare older elements include *Crybelosporites striatus* (very rare above the Albian) and Permian taxa, presumed reworked.

Dinoflagellates include Eocene *A. ornata, Heteraulacysta* sp and *A. homomorphum*, Paleocene *D. obliquipes*, Maastrichtian *M. druggii*, Campanian *N. aceras* and *X. australis*, with *Heterosphaeridium* spp and *Spiniferites* spp the most consistent. Most, if not all, are considered caved.

Marginal marine environments are suggested by the common freshwater algae *Botryococcus*, dominant and diverse spores and pollen, and minor dinoflagellates. However, much of the assemblage is caved.

Yellow to light brown darkest spore colours suggest immaturity for hydrocarbons. The Tertiary elements are mostly colourless.

These features suggest nothing older than the overlying samples, but barren sandstones (?Waare Sandstone) would be consistent with these data.

3.6 1287-1290m (cutts) : *paradoxa* Spore-pollen Zone (no dinocyst Zone)

Assignment to the *Coptospora paradoxa* Spore-pollen Zone of Albian age is indicated by youngest *C. paradoxa*, coincident with youngest *Triporoletes reticulatus, Triporoletes bireticulatus, Appendicisporites distocarinatus* and downhole influxes of *Cicatricosisporites australiensis, Crybelosporites striatus* and other spores. Overall, *C. minor* and *F. similis* are common, with *Gleicheniidites, Laevigatosporites ovatus, M. antarcticus, O. wellmanii, P. microsaccatus* and *V. pallidus* frequent. Obviously caved are Eocene-Paleocene *Intratriporopollenites notabilis, H. harrisii* and Late Cretaceous *A.*

4 CONCLUSIONS

Palynology results are not precise due to the apparent heavy caving in these cuttings and poor yields in sandy section. Samples towards the base are particularly problematic, and the section may be fairly incomplete.

Present only as caving are the Middle Eocene (on *Deflandrea phosphoritica* and *Alisocysta ornata*), Early Eocene (*Homotriblium tasmaniense*), probable late Paleocene (*Deflandrea dartmooria* and *D. obliquipes*) and Maastrichtian (*longus/druggii* Zones) all above the sampled section. Probably in place are early Campanian (*senectus/aceras* Zones) and probably Santonian (mid *apoxyexinus* Zone, possible Turonian (lower *mawsonii* Zone) and Albian (*paradoxa* Zone).

Normally distinctive but not seen even as caving are the *lillei/korojonense* Zones, lower *senectus*-upper *apoxyexinus*/lower aceras-upper *cretacea* Zones and lower *apoxyexinus/porifera* Zones. These are probably absent. Bland and non-distinctive are the upper *senectus/australis* Zones, upper *mawsonii/striatoconus* Zones and *distocarinatus*/unzoned Zones. These may be barren sands, absent or masked by caving from the more distinctive horizons.

5 REFERENCES

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